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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This is a final report on the purchase and installation of a Molecular Beam Epitaxial (MBE) Deposition Machine. Additional funds were provided by the National Science Foundation, by USCD intramural contributions and by the Powell (private) foundation for a total of $471,000. The machine presently in operation is a modified Varian Associates Gen.II Machine without the low energy electron diffraction and without the Auger surface spectrometer.

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Final Report

Molecular Beam Epitaxy for Combined Optical and Electronic Circuits

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Date: December 24th, 1984

The Grant of $257,000 provided by the U.S. Air Force Office of Sientific Research under the Department of Defense - University Research Instrumentation Program (FY 1983) to the University of California, San Diego in La Jolla, CA 92093 was used as partial support for the purchase of a Molecular Beam Epitaxial (MBE) Deposition Machine. Additional funds were provided by the National Science Foundation, by UCSD intramural contributions and by the Powell (private) foundation for a total of $471,000.

The MBE machine purchased, installed and presently in operation is a modified Varian Associates Gen.II Machine without the low energy electron diffraction and without the Auger surface spectrometer. The system is superior to the older model Varian 360 but inferior to the Gen.II model which is, however, more expensive by an estimated $300,000.

The machine was delivered in June 1984. However, some additional components, primarily Knudsen effusion cells and a Quadropole Mass Spectrometer, donated by Varian Associates were not delivered until July 1984. From August through October initial checkout procedures indicated minor defects: an out of round transfer rod, a broken heater filament in the substrate holder and some defective linkage in the specimen loader. These were easily repaired and from October 1984 through December 1984 we have gone through the initial checkout procedures for growing epitaxial layers. During that period, twelve gallium arsenide single crystal layers were grown on semi-insulating gallium arsenide substrates in the thickness range between 2.5 micrometers to 0.05 micrometers of excellent morphological characteristics. We consider the MBE system to be well within its specifications and anticipate growing ternary alloy gallium arsenide layers during January and February, 1985.

By March 1985 the MBE system will be used to grow ternary III-V compound alloy heterojunction structures and to initiate a wide ranging program intended to provide the foundations for Combined Electronic and Optical Integrated Circuits.

The objective of this research is the development of a scientific basis for a combined high speed optical and electronic signal processing integrated circuit technology based on the fundamental properties of the ternary alloy $Ga_{0.47}In_{0.53}As$ and of its matched heterojunctions and of the quaternary alloys $Ga_xIn_{1-x}As_yP_{1-y}$ and of their heterojunctions matched to InP. This will be implemented by a planar monolithic process using a combination of field effect transistors, phototransistors, optical sources and detectors for the generation, detection, modulation and switching of electronic and optical signals.